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(72) Inventors:
 • **Kakarala, Ramakrishna**
Sunnyvale, CA 94086 (US)
 • **Baharav, Izhak**
San Jose, CA 95124 (US)

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(74) Representative: **Liesegang, Eva et al**
Forrester & Boehmert,
Pettenkoferstrasse 20-22
80336 München (DE)

(71) Applicant: **Agilent Technologies, Inc.**
Palo Alto, CA 94306 (US)

(54) **Method and system for adaptive demosaicing**

(57) An adaptive demosaicing method is disclosed that interpolates images based on color edge detection and neighborhood voting. The adaptive demosaicing algorithm uses a voting scheme to determine the direction of interpolation at each missing luminance pixel location. Each color plane votes either horizontal or vertical based on a comparison between the vertical and horizontal components of the degree of change (i.e., gradi-

ent, Laplacian or other measure of the degree of change) in that color plane. Votes are counted from the neighborhood pixels as well as from measurements taken at the pixel location itself. Once the luminance plane is fully interpolated, the chrominance planes are filled in by a simple bilinear or median interpolation of difference chrominance values. Enhancements to the adaptive demosaicing algorithm permit adaptive smoothing and sharpening.

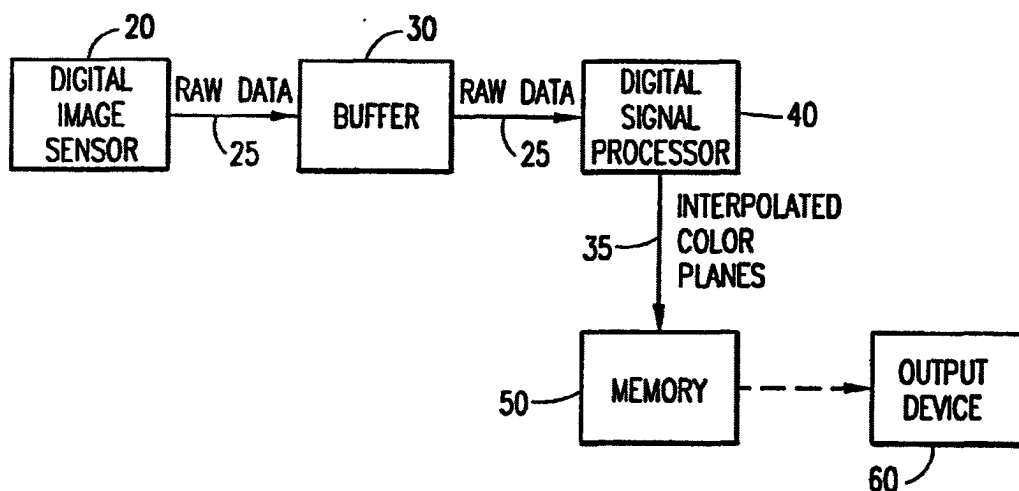


FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 02 00 9959

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 2001/005429 A1 (ISHIGA KENICHI ET AL) 28 June 2001 (2001-06-28)	1-8, 10-15, 19-21, 23-29	H04N9/04
A	* abstract *	9,22	
Y		16-18, 30,31,33	
Y	* paragraphs [0009], [0019], [0020], [0023] * * paragraph [0109] * * paragraph [0125] * * paragraphs [0127] - [0162]; figures 5D-5E * * paragraphs [0165], [0169] * * paragraphs [0171], [0176], [0178]; figures 9A-9B * * paragraphs [0295], [0299] - [0313]; figure 13 * * figure 28 *	32	
D,A	----- US 5 652 621 A (ADAMS, JR. ET AL) 29 July 1997 (1997-07-29) * abstract; figures 3,5 *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	----- PATENT ABSTRACTS OF JAPAN vol. 2000, no. 01, 31 January 2000 (2000-01-31) & JP 11 275373 A (NIKON CORP), 8 October 1999 (1999-10-08) * abstract *	1	H04N
Y	----- US 6 034 724 A (NAKAMURA ET AL) 7 March 2000 (2000-03-07) * abstract * * column 8, line 10 - column 9, line 27 * ----- -/--	16,30	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 October 2005	Examiner Mao, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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Application Number
EP 02 00 9959

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 13, 30 November 1999 (1999-11-30) & JP 11 215515 A (EASTMAN KODAK JAPAN LTD), 6 August 1999 (1999-08-06) * abstract *	17,18, 31,33	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
L	-& US 6 526 181 B1 (SMITH CRAIG M ET AL) 25 February 2003 (2003-02-25) * L : as translation of JP 11 215 515 * * abstract * * column 1, line 57 - column 2, line 8 * * column 2, lines 32-35 * * column 5, lines 10-19 * * column 5, line 47 - column 8, line 45 * * column 8, lines 46-52 * * column 8, lines 53-58 *	17,18, 31,33	
Y	US 6 229 578 B1 (ACHARYA TINKU ET AL) 8 May 2001 (2001-05-08) * abstract * * column 4, line 29 - column 5, line 51 *	17,18, 31,33	
A	WO 99/39509 A (KONINKLIJKE PHILIPS ELECTRONICS N.V.; PHILIPS AB) 5 August 1999 (1999-08-05) * abstract *	17,18, 31,33	
Y	US 5 808 674 A (ADAMS, JR. ET AL) 15 September 1998 (1998-09-15) * column 2, lines 59,60 * * column 6, lines 12-41 *	32	
Y	US 6 091 862 A (OKISU ET AL) 18 July 2000 (2000-07-18) * column 4, line 63 - column 5, line 28; figure 3 *	32	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 October 2005	Examiner Mao, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EUROPEAN SEARCH REPORT

Application Number
EP 02 00 9959

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	EP 1 111 904 A (TEXAS INSTRUMENTS INCORPORATED) 27 June 2001 (2001-06-27) * paragraphs [0054], [0055] * -----	32	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 10 October 2005	Examiner Mao, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



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**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-5,6-8,10-15,19-21,23-29

Determination of interpolation orientation

2. claims: 9,22

Interpolation considering low-light level situations

3. claims: 16-18,30-31,33

Smoothing for noise reduction

4. claim: 32

Sharpness enhancement

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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10-10-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2001005429 A1	28-06-2001	NONE	
US 5652621 A	29-07-1997	NONE	
JP 11275373 A	08-10-1999	NONE	
US 6034724 A	07-03-2000	JP 9238355 A	09-09-1997
JP 11215515 A	06-08-1999	US 6526181 B1	25-02-2003
US 6526181 B1	25-02-2003	JP 11215515 A	06-08-1999
US 6229578 B1	08-05-2001	AU 1411999 A	28-06-1999
		EP 1038159 A2	27-09-2000
		JP 2002503894 T	05-02-2002
		TW 455781 B	21-09-2001
		WO 9930547 A2	17-06-1999
WO 9939509 A	05-08-1999	JP 2002510456 T	02-04-2002
		US 6727945 B1	27-04-2004
US 5808674 A	15-09-1998	NONE	
US 6091862 A	18-07-2000	JP 3503372 B2	02-03-2004
		JP 10164602 A	19-06-1998
EP 1111904 A	27-06-2001	NONE	